COMPARATIVE ANALYSIS OF SUSTAINABLE DEVELOPMENT OF PROVINCES

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Abstract

Sustainable development involves integration of political, economic and social activities maintaining natural balance and durability of basic natural processes in order to ensure the possibility to fulfil the essential needs of individual communities or citizens, for both present and future generations. An attempt was made in the paper to evaluate the provinces in view of sustaining their development. A set of 71 indicators was used to describe the individual areas of sustainable development, i.e. economic, environmental and institutional-political order in a synthetic way. Linear ordering of provinces was conducted using their taxonomic distance from the model object.

Keywords: province, sustainable development, indices, order

INTRODUCTION

The concept of sustainable development has been currently the best way to arrange contemporary world, which gives a chance for lasting and development of humanity, both on a global and local scale. The idea has been evolving since the mid-20th century. The intensive economic development which took place following the years of recovery from the devastation of the 2nd World War was conducted without attaching proper attention to ecological or social issues (Burchard-Dziubińska *et al*. 2014). The changes which occurred in the natural environment were often characterized as ecological disasters. These in turn, be-

came an impulse to undertake activities to improve ecological awareness and to protect the natural environment. Sustainable development is a process integrating social, economic and environmental phenomena in such a way as to ensure development over a long time for the present and future generations. Vision contained in the definition of sustainable development presented in the Report of the United Nations World Commission on Environment and Development of 1987 comprises human population, the animal and plant world, ecosystems and the Earth natural resources, power-generating raw materials, but also in an integrated way treats the most important challenges which the world faces, such as poverty fight, gender equality, human rights and his safety, education for all people, health and intercultural dialogue (Bal-Domańska, Wilk 2011). According to Diamond (2005, 2010), development of human populations and contemporary world was in the first place determined by the natural conditions, which made possible passing from hunting and gathering lifestyles to sedentary agriculture and the subsequent change of the organization of society. These factors made possible growth of the population number, increasing military potential and formation of new social groups.

Sustainable development of the country, recognized as the Constitutional Principle of the Republic of Poland, was defined in the Act on Natural Environment Protection as the socio-economic development in which the integration process of political, economic and social activities takes place at the same time preserving the environmental balance and permanence of basic natural processes in order to ensure fulfilment of individual communities basic needs for both present and future generations (GUS 2011). The overall objective of striving for sustainable development is a lasting improvement of the life quality through forming the right proportions in the economic-spatial and social, as well as in institutional and political dimensions (Borys 2005).

AIM, SCOPE AND METHOD

Monitoring the results of undertaken activities plays an important role in the process aiming at sustainable development. An assessment and comparison of provinces in the context of sustainable development were made in the article. The indices available for characterizing four areas (orders) of sustainable development: social, economic, environmental and institutional-political were applied for the assessment.

The assessment of development sustainability is a complicated task. It is particularly difficult to define and then select measurable indices which unambiguously describe the studied phenomenon. Another issue is pointing out the optimal indices values. There are no clear premises as to determining the desired

level of phenomena and problems occur for each of the indices in determining the target level common for all studied units (Bal-Domańska, Wilk 2011).

All four aspects of sustainable development mentioned before were used in the paper. It was assumed, with great simplification, that the target values of the indices for stimulants will be their maximum values whereas for the inhibitors their minimum values. However, the values should not be identified with the optimal values because assumed target values (maximum or minimum) may to a great extent differ from the values which are the most advantageous for the studied phenomenon. In such cases, the values of synthetic measures indicate a closer position towards the model than it would result from the optimal situation (Bal-Domańska, Wilk 2011).

The study used 71 indices characterizing all four aspects of sustainable development: social aspect – 31 indices, economic aspect – 17 indices, environmental aspect – 15 indices, and institutional-political aspect – 8 indices. Selection of diagnostic features was determined by their suitability for an assessment of sustainable development and availability of comparable data for the years 2010 and 2016. The necessary data was retrieved from the Bank and Data Base of the Central Statistical Office (wskaznikizrp.stat.gov.pl).

The assessment of the level of provinces sustainable development involved forming rankings using a synthetic measure of development in each studied aspect of this development.

The following procedure was applied to set a synthetic measure of development:
1. Normalization of variables according to the following formula:

$$x'_{ij} = \frac{x_{ij} - minx_{ij}}{maxx_{ij} - minx_{ij}}$$

Where:

x'_{ij} – value of transformed (normalized j-th diagnostic feature in the i-th object (province)),

x_{ij} – real value of the j-th diagnostic feature in the i-th object,

$minx_j$ – minimum value of the j-th feature,

$maxx_j$ – maximum value of the j-th feature.

In effect of this transformation (unitarization) values of the features fall within the range [0;1].

2. All analyzed indices were treated as stimulants or inhibitors, by changing the inhibitors (x'^D_{ij}) into stimulants (x'^S_{ij}) according to the following formula:

$$x'^S_{ij} = \frac{1}{x'^D_{ij}}$$

3. The model object was the one which was characterized by the highest values of stimulants and the lowest values of inhibitors:

$x_{0j}=maxx'_{ij}$ *for stimulant,*

and

$x_{0j}=minx'_{ij}$ *for inhibitor.*

4. Determination of synthetic measure of development of the *i-th* object was conducted according to the following formula:

$$d_i = 1 - \frac{d_{i0}}{d_0}$$

Where:

$$d_{i0} = \left[\sum_{j=1}^{p}(x_{ij} - x_{0j})^2\right]^{\frac{1}{2}}$$

is the Euclidean distance of the *i-th* object from the model object, whereas is the distance between the model and anti-model. The anti-model is characterized by the lowest values of stimulants and highest values of inhibitors.

5. Compatibility assessment of the provinces ordering in the years 2010 and 2016 was conducted using Pearsons' linear correlation coefficient.

RESULTS OF RESEARCH ON THE ASSESSMENT OF SUSTAINABILITY OF PROVINCES DEVELOPMENT

The value of synthetic measure of provinces sustainable development in the individual dimensions (social, economic, environmental and institutional-political) for the years 2010 and 2016 was presented in Table 1.

It may be seen from Table 1 that over the studied period changes took place with reference to all orders and were occurring both towards development sustainability and in the opposite direction. In case of social order in ten provinces the values of this synthetic index increased. Such trend was observed also in eleven provinces for economic order and only in five provinces for environmental order. In all provinces an improvement occurred for institutional-political order.

Improvement of the quality of all aspects was observed in two provinces: Lubuskie and Pomorskie, whereas in Warmińsko-mazurskie a decline in the value of synthetic index was noticed for three orders. In the other provinces a decrease in the value of synthetic index in two areas was stated for a majority of cases.

Table 1. Values of synthetic index of sustainable development (d_i) of provinces according to orders (dimensions) in the years 2010 and 2016.

Province	Social order			Economic order			Environmental order			Institutional-political order		
	2010	2016	change	2010	2016	change	2010	2016	change	2010	2016	change
Łódzkie	0.401	0.404	0.003	0.284	0.341	0.057	0.231	0.206	-0.024	0.381	0.459	0.078
Mazowieckie	0.464	0.461	-0.003	0.402	0.430	0.028	0.249	0.255	0.006	0.265	0.270	0.005
Małopolskie	0.488	0.473	-0.015	0.320	0.339	0.019	0.330	0.280	-0.050	0.264	0.373	0.109
Śląskie	0.437	0.474	0.037	0.356	0.344	-0.012	0.237	0.212	-0.025	0.354	0.357	0.003
Lubelskie	0.323	0.355	0.033	0.223	0.241	0.017	0.322	0.316	-0.006	0.247	0.274	0.027
Podkarpackie	0.235	0.269	0.034	0.244	0.246	0.003	0.469	0.438	-0.031	0.335	0.345	0.01
Podlaskie	0.391	0.404	0.013	0.196	0.229	0.033	0.463	0.429	-0.034	0.293	0.270	-0.023
Świętokrzyskie	0.264	0.294	0.031	0.243	0.160	-0.082	0.272	0.279	0.007	0.460	0.339	-0.121
Lubuskie	0.376	0.379	0.003	0.294	0.314	0.019	0.407	0.416	0.008	0.403	0.412	0.009
Wielkopolskie	0.536	0.527	-0.009	0.391	0.391	0.000	0.351	0.302	-0.049	0.424	0.451	0.027
Zachodnio-pomorskie	0.344	0.386	0.042	0.312	0.305	-0.007	0.313	0.302	-0.011	0.452	0.409	-0.043
Dolnośląskie	0.362	0.453	0.091	0.363	0.401	0.038	0.261	0.236	-0.025	0.452	0.531	0.079
Opolskie	0.435	0.423	-0.011	0.321	0.299	-0.022	0.252	0.265	0.013	0.488	0.518	0.03
Kujawsko-pomorskie	0.376	0.374	-0.002	0.310	0.319	0.009	0.363	0.346	-0.017	0.350	0.340	-0.01
Pomorskie	0.503	0.514	0.011	0.437	0.447	0.010	0.327	0.339	0.012	0.361	0.394	0.033
Warmińsko-mazurskie	0.324	0.294	-0.030	0.252	0.171	-0.081	0.482	0.417	-0.066	0.458	0.305	-0.153

Source: own studies

Table 2. Ranking of provinces and their changes according to individual orders

Province	Social order			Economic order			Environmental order			Institutional-political order		
	2010	2016	change	2010	2016	change	2010	2016	change	2010	2016	change
Łódzkie	7	8	-1	11	6	5	16	16	0	8	3	5
Mazowieckie	4	5	-1	2	2	0	14	13	1	14	15	-1
Małopolskie	3	4	-1	7	7	0	7	10	-3	15	8	7
Śląskie	5	3	2	5	5	0	15	15	0	10	9	1
Lubelskie	14	13	1	15	13	2	9	7	2	16	14	2
Podkarpackie	16	16	0	13	12	1	2	1	1	12	10	2
Podlaskie	8	9	-1	16	14	2	3	2	1	13	16	-3
Świętokrzyskie	15	14	1	14	16	-2	11	11	0	2	12	-10
Lubuskie	9	11	-2	10	9	1	4	4	0	7	5	2
Wielkopolskie	1	1	0	3	4	-1	6	8	-2	6	4	2
Zachodnio-pomorskie	12	10	2	8	10	-2	10	9	1	4	6	-2
Dolnośląskie	11	6	5	4	3	1	12	14	-2	5	1	4
Opolskie	6	7	-1	6	11	-5	13	12	1	1	2	-1
Kujawsko-pomorskie	10	12	-2	9	8	1	5	5	0	11	11	0
Pomorskie	2	2	0	1	1	0	8	6	2	9	7	2
Warmińsko-mazurskie	13	15	-2	12	15	-3	1	3	-2	3	13	-10

Source: own studies

Another worrying phenomenon is the fact that sustaining development of the analyzed provinces, i.e. improvement of the value of synthetic indices occurs at the expense of the natural environment. In case of this area the highest number of cases of decline in the value of synthetic index was noted.

Table 2 presents the ranking of provinces according to individual orders.

A cursory examination of the data in Table 2 reveals a considerable dynamics of changes in the provinces ranking. A comparison of data from the year 2010 and 2016 evidences the best stabilization of the provinces ranking for environmental order, where in five cases no change in a position was registered. The highest dynamics was observed for institutional-political order – only in one case (Pomorskie province) no change of position was noted. While comparing the results in Table 1 with those in Table 2, it was noticed that a decrease in the synthetic index value (Table 1) does not unanimously affect the position of the province in a ranking (Table 2). No province revealing a dominant position in the sphere of all studied areas was pointed out. It was not a rule that a high position in the ranking at the same time denoted occurrence of positive changes of synthetic index value. The most apparent example is Wielkopolskie province. Considering the social order it occupies the first place both in 2010 and in 2016; however, the value of synthetic index of this order in 2016 is lower than in 2010.

Table 3. Basic statistics of synthetic index d_i according to studied orders

Statistics	Social order		Economic order		Environmental order		Institutional-political oder	
	2010	2016	2010	2016	2010	2016	2010	2016
minimum	0.235	0.269	0.196	0.160	0.231	0.206	0.247	0.270
maximum	0.536	0.527	0.437	0.447	0.482	0.438	0.488	0.531
mean	0.391	0.405	0.309	0.311	0.333	0.315	0.374	0.378
Variation coefficeint	0.214	0.191	0.221	0.273	0.254	0.243	0.210	0.217
Pearson's linear correlation coefficient	0.936		0.978		0.960		0.648	

Source: own studies

The values of basic statistics of synthetic index d_i in Table 3 with reference to the individual orders and studied periods indicate an increase in mean values of synthetic index of development in the social, economic and institutional-political areas. A disturbing fact is a decline in the mean value of synthetic index for environmental order. On the other hand, a decrease in the value of variation coefficient for social and environmental orders indicate progressive, yet very slow blurring the differences between the quality of social and natural environment in the studied provinces. Unfortunately, increased variation coefficient was regis-

tered in the economic and institutional-political areas, which evidences greater disproportion in the development in these two areas.

Computed values of Pearson's linear correlation coefficient between the values of synthetic index of development in the years 2010 and 2016 revealed a high correlation in the social, economic and environmental areas. It means that the succession of the provinces in the ranking did not change significantly. On the other hand, in the institutional-political area the correlation may be determined as moderate. In this case changes occurred in the ranking in over forty percent of provinces.

From the sustainable development perspective, it is recommended to consider the changes complexively, i.e. including all areas of these changes. Table 4 shows the ranking of provinces considering the sustainable development taking into account mean value of synthetic index computed on the basis of this index values in the individual orders.

Table 4. Ranking of provinces according to mean value of synthetic index d_i

Province	Mean value of index d_i			Position		Change of position
	2010	2016	change	2010	2016	
Łódzkie	0.259	0.282	0.023	13	8	5
Mazowieckie	0.276	0.283	0.007	11	7	4
Małopolskie	0.280	0.293	0.013	8	6	2
Śląskie	0.277	0.277	0.001	10	10	0
Lubelskie	0.223	0.237	0.014	16	15	1
Podkarpackie	0.257	0.260	0.003	14	13	1
Podlaskie	0.269	0.266	-0.002	12	12	0
Świętokrzyskie	0.248	0.214	-0.033	15	16	-1
Lubuskie	0.296	0.304	0.008	5	4	1
Wielkopolskie	0.340	0.334	-0.006	1	2	-1
Zachodnio-pomorskie	0.284	0.280	-0.004	7	9	-2
Dolnośląskie	0.288	0.324	0.037	6	3	3
Opolskie	0.299	0.301	0.002	4	5	-1
Kujawsko-pomorskie	0.280	0.276	-0.004	9	11	-2
Pomorskie	0.326	0.339	0.013	2	1	1
Warmińsko-mazurskie	0.303	0.237	-0.066	3	14	-11

Source: own studies

Analysis of data from Table 4 shows that the increase in the value of synthetic index causes shifting of a province up the ranking. It has been con-

firmed by the conducted statistical analysis. Computed value of Pearsons's linear correlation coefficient between the value of synthetic index change and the change of position for the years 2010 and 2016 is 0.884. According to this ranking in 2010 Wielkopolskie province was on the first place, Pomorskie on the second, while Warmińsko-mazurskie on the third. In 2016 Wielkopolskie and Pomorskie provinces switched places, whereas Warmińsko-mazurskie fell to the 14th position. Such apparent fall of Warmińsko-mazurskie province position in the ranking was affected by a decrease in the values of synthetic indices for this province in all orders, particularly a considerable decline in the institutional-political order. Considering this order, increase in this index value or its minimum decrease occurred in the other provinces. An apparent improvement was noticed for Łódzkie province. It moved up the ranking by five positions. It was in the first place determined by positive changes in the economic and institutional-political areas.

CONCLUSION

For a proper assessment of sustainable development a thorough analysis of the conditionings for this development should be conducted by a team of specialists in life, social and political sciences. The analysis should be then subjected to a synthesis in order to avoid mutual contradictions. Such contradictions may be noticed for currently used indices of sustainable development. In 2011 the Central Statistical Office suggested application of 76 indices of sustainable development and in 2015 – 101 indices (GUS 2011, GUS 2015). A comparison of both lists of indices clearly shows their increased number, particularly with reference to economic order. Unfortunately, there is still no information about the optimum values for the individual indices. Therefore, it has been assumed in the paper that the optimal values are maximum values of stimulants and minimum values of inhibitors. In some cases, such simplification may lead to contradictory conclusions. Moreover, there are no data available about the values of individual indices by regions.

Conducted studies do not allow for stating unanimously that Poland is developing in a sustainable way. Considering the presented studies, one can speak about sustainable development when the values of synthetic values referring to all orders in 2016 would increase in relation to the preceding period, i.e. the year 2010. This situation was observed only in Lubuskie and Pomorskie provinces.

Analyzing the results of the studies one should consider the specific character of the provinces (their location, economic profile and history) as well as their internal diversification. Another factor is time. The period of studies was relatively short.

It should be said that for a more detailed description of the development of sustainability, a more exhaustive specification of development indices should be

made and then their optimal values should be determined including characteristics of the studied area. A reduction in the number of indices suggested by CSO should be also taken into consideration.

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